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⑤④ Gel preparations for external application.

⑤⑦ A gel preparation for external application by being prepared from diclofenac sodium as the active ingredient, water, lower alkanols and glycols as medium, a carboxyvinyl polymer as gelating agent, a weak basic substances and optionally adding peppermint oil,  $\ell$ -menthol or salicylic acid ester as auxiliary agent.

## SPECIFICATION

## 1. TITLE OF THE INVENTION

Gel preparations for external application

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## 2. BACKGROUND OF THE INVENTION

Field of the invention

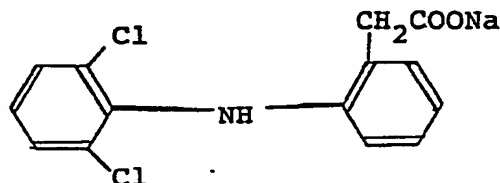
The present invention relates to gel preparations for external application containing diclofenac sodium as active ingredient and having good stability and nice feeling on use.

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Description of the Prior Art

Diclofenac sodium is a derivative of phenylacetic acid represented by the formula:

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which is a non-steroid drug soluble in water and alcohols

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having excellent antiinflammatory and analgetic effects.

For the present, it is used only in the form of oral preparations or suppositories and shows excellent antiinflammatory and analgetic effects. However, side effects such as stomach and intestines trouble, liver trouble and kidney trouble, are at issue, especially in the case of the oral administra-

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tion. Therefore, antiinflammatory and analgetic preparations which are absorbed cutaneously without showing such side effects are desired.

5        In this regard, a gel preparation for external application containing indomethacin, a non-steroid drug, is known ( Japanese Patent Laid-open No. Sho 53(1978)-81616). In this preparation, however, there is a question of stability and there is a defect that its yellow color due to the color of indomethacin itself soils clothes as it is applied on the  
10       skin. Thus, the inventor of the present invention has found preparations for external applicaiton which consist of a solution comprising another non-steroid compound having anti-inflammatory and analgetic effects, at least one of peppermint oil and salicylic acid ester in an amount sufficient to  
15       dissolve the non-steroid compound and a base for external application (Japanese Patent Application No. Sho 56(1981)-128032). However, any and every compound having antiinflammatory and analgetic effects, which may be used in such preparations, is limited to water-insoluble one.

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### 3. SUMMARY OF THE INVENTION

      The present invention provides gel preparations for external application characterized by being prepared from diclofenac sodium as the active ingredient, water, lower  
25       alkanols and glycols as medium, a carboxyvinyl polymer as

gelating agent and a weak basic substance as neutralizing agent. The gel preparations for external application of this invention have good stability and nice feeling on use and show excellent antiinflammatory and analgetic effects  
5 by cutaneous absorption.

#### 4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a graph showing changes with the lapse of time in the amount of diclofenac sodium contained in the preparation of Example 1 of the present invention, and Figs.  
10 2 to 4 are graphs showing changes with the lapse of time in the amount of diclofenac sodium contained in the preparations of Referential Examples 1 to 3, respectively.

#### 15 5. DESCRIPTION OF THE PREFERRED EMBODIMENTS

The content of diclofenac sodium, the active ingredient, in the gel preparation of the present invention is usually 0.3 to 3.0 % by weight, preferably, 0.5 to 2.0 % by weight of the preparation.

20 As the medium for the active ingredient, water, lower alkanols and glycols are used.

It is possible to prepare a stable gel preparation of diclofenac sodium using as medium a combination of water and lower alkanols or a combination of water and glycols.  
25 However, when water and a lower alkanol are used, absorption

of the active ingredient diclofenac sodium is not good, because the preparation gets dry so easily that diclofenac sodium crystallizes out on the surface of the skin. On the other hand, when water and a glycol are used as medium, it is necessary to use the glycol in an amount of at least 30 % or more, in consideration of irritation which may be caused by pH on the skin. Nevertheless, if a glycol is used for the gel preparation in an amount of 30% or more, the preparation does not get dry well as applied on the skin. Moreover, the irritation on the skin by the glycol remains still as a problem.

Therefore, it is required to use a combination of water, lower alkanols and glycols.

The medium in the preparation of the present invention is used in such amount as is sufficient at least to dissolve the active ingredient and as constitutes the whole preparation together with the gelating agent, the neutralizing agent, the active ingredient, etc.

The ratio by weight of water to organic solvents in the medium is, for example, from 8:2 to 4:6. It is preferred that water is 80 % by weight or less, lower alkanols are 60 % by weight or less and glycols are 40 % by weight or less of the medium. As a preferable mixing ratio by weight for the medium use in the present invention, there can be mentioned a ratio of water: lower alkanols: glycols of approximately 60 : 30 : 10.

As the lower alkanols, there can be mentioned methanol, ethanol, propanol, iso-propanol butanol and the like. Among these, ethanol and iso-propanol are preferred.

As the glycols, ethylene glycol, propylene glycol and 1,3-butylene glycol are mentioned. The preferred among these are propylene glycol and 1,3-butylene glycol.

The most preferable combination for the medium of the above three solvents is water: ethanol: propylene glycol or water: ethanol: 1,3-butylene glycol.

Carboxyvinyl polymers used as the gelating agent are hydrophilic polymers obtained by polymerization of acrylic acid as the main component. It is desirable to use a commercial product. As commercially available products, there can be mentioned Hiviswako 103, Hiviswako 104, and Hiviswako 105 from Wakojunyakukogyo K.K. in Japan, Carbopol 934, Carbopol 940 and Carbopol 941 from Goodrich Chemical Co. in U.S.A., and the like.

In the preparations of the present invention, weak basic substances are used as the neutralizing agent in such amount as enables to adjust the preparations almost neutral, that is, at a pH of 6 - 8, preferably, a pH of 6.5 - 7.5. An amount of, for example, 0.1 - 5 % by weight of the preparation would suffice to attain the purpose.

As the weak basic substances, aliphatic amines are preferred. The aliphatic amines include primary, secondary

and tertiary alkanolamine and primary, secondary and tertiary  
alkylamines. As concrete examples of the alkanolamines, there  
can be mentioned monoethanolamine, diethanolamine, diisopropanolamine,  
triethanolamine, triisopropanolamine, etc. As the alkylamines are  
5 mentioned dimethylamine, diethylamine, trimethylamine, tri-  
ethylamine and the like. Especially preferred among these  
are triethanolamine and diisopropanolamine. To use such weak  
basic substance as the neutralizing agent is one of the  
characteristic features of the present invention. It is  
10 proved that to use a strong base such as sodium hydroxide as  
the neutralizing agent is improper. Comparing carboxyvinyl  
polymers with diclofenac in the form of free acid, the acidity  
of the former is stronger than that of the latter. However,  
carboxyvinyl polymers are by themselves weak acids. Accordingly,  
15 when a strong base such as sodium hydroxide is used as the  
neutralizing agent, the pH value increases to about 9.  
Although it is possible to prepare gel preparations of diclofenac  
sodium using a gelating agent under such condition, the strong  
basicity increased to a pH value of about 9 is undesirable  
20 for the preparations for external application because it causes  
irritation on the skin. On the other hand, when gel preparations  
of diclofenac sodium are prepared without neutralizing the  
carboxyvinyl polymer with sodium hydroxide, the free acid of  
diclofenac is formed in the resulting gel preparations since  
25 the sodium ion of diclofenac sodium combines with said carboxy-

vinyl polymer having an acidity stronger than diclofenac even if the polymer were under the pH condition of about 7. Although diclofenac in the form of sodium salt is stable, diclofenac itself is hardly soluble and loses stability in the preparations with the lapse of time.

Further, to the gel preparation of the present invention, at least one of peppermint oil, l-menthol, methyl salicylate, ethyl salicylate and glycol monosalicylate may be added, if desired. Peppermint oil and l-menthol give cool feeling to the skin, and salicylic acid derivatives accelerate cutaneous absorption of the active ingredient. They are applied as an inductive stimulant in the case of pain complaints and increase the analgetic effects. These auxiliary agents are added to the gel preparations usually in an amount of 0.5 to 5 % by weight.

Although there is no limitation on the method of preparing the gel preparation of the present invention, they can be prepared, for example, according to the following

methods: Diclofenac sodium is dissolved in a lower alkanol. To the solution obtained are added an aqueous solution of a carboxyvinyl polymer and glycol, while stirring. Then, a neutralizing agent is added further to the solution, while stirring, in such amount as adjusts the pH of the resulting gel preparation at about 6 - 8. Thus, the gel preparation of the present invention is obtained. The gel preparation of the present invention can be prepared also by adding an aqueous



solution of a carboxyvinyl polymer to a solution obtained by dissolving diclofenac sodium in a mixture of a lower alkanol and a glycol, while stirring, and then adding a neutralizing agent to the resulting solution while stirring.

5           To the gel preparation of the present invention, those applicable in the art, such as aromatic agent, antiseptic agent, coloring agent, etc., may be added in a small amount, besides the salicylic acid esters as mentioned above, if so desired. However, good preparations are obtained usually  
10 without necessity for adding such additives.

          The gel preparation of the present invention thus obtained have good stability. They do not show any change in the viscosity even at high temperatures and any crystallization at low  
15 temperatures. Moreover, they adhere well to the skin and spread very well. Further, they do not give sticky feeling and they get dry easily.

          In the following, the present invention is illustrated by giving Examples of the preparations of the present invention and Referential Examples of preparations having a similar  
20 composition and a low pH value. However, the invention shall not be limited to these Examples.

#### Example 1

          Diclofenac sodium (1g) was dissolved in 95% ethanol  
25 (30g) while stirring. On the other hand, propylene glycol

(10g), 4% aqueous solution (25g) of a carboxyvinyl polymer Carbopol 940 and purified water (20g) were mixed uniformly by stirring, and triethanolamine (1.5g) was added to the mixture while continuing the stirring. To the gel base thus prepared, the alcoholic solution of diclofenac sodium previously prepared was added and the whole was adjusted to 100g by further adding purified water. After stirring well, a gel preparation having a viscosity of 20,000 centipoise and a pH of 7.15 was obtained.

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## Example 2

Diclofenac sodium (0.5g) was dissolved in 95% ethanol (25g) while stirring. On the other hand, 1,3-butylene glycol (20g), 4% aqueous solution (25g) of Carbopol 940 and purified water (20g) were mixed uniformly by stirring, and triethanolamine (1.5g) was added to the mixture while continuing the stirring. To the gel base thus prepared, the alcoholic solution of diclofenac sodium previously prepared was added and the whole was adjusted to 100g by further adding purified water. After stirring well, a gel preparation having a viscosity of 22,000 centipoise and a pH of 7.15 was obtained.

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## Example 3

Diclofenac sodium (3.0g) and l-menthol (0.5g) were dissolved in 95% ethanol (40g) by stirring. On the other

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hand, propylene glycol (10g), 4% aqueous solution (25g) of Carbopol 940 and purified water (15g) were mixed uniformly by stirring, and diisopropanolamine (3.0g) was added to the mixture while continuing the stirring. To the gel base thus prepared, 5 the alcoholic solution of diclofenac sodium previously prepared was added and the whole was adjusted to 100g by further adding purified water. After stirring well, a gel preparation having a viscosity of 17,000 centipoise and a pH of 7.20 was obtained.

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## Referential Example 1

Diclofenac sodium (1.0g) and peppermint oil (3.0g) were dissolved in 95% ethanol (40g) by stirring. Separately, 3% solution (20g) of Carbopol 940 in propylene glycol, 4% 15 aqueous solution (25g) of Carbopol 940, citric acid (0.3g) and purified water (8.0g) were mixed uniformly by stirring, and triethanolamine (0.05g) was added to the mixture while continuing the stirring. To the gel base thus prepared, the alcoholic solution of diclofenac sodium and peppermint oil prepared 20 previously was added and the whole was adjusted to 100g by further addition of purified water. After stirring well, a gel preparation having a viscosity of 22,000 centipoise and a pH of 5.2 was obtained.

25 Referential Example 2

Diclofenac sodium (1.0g) was dissolved in 95% ethanol (40g) by stirring. Separately, 3% solution (20g) of Carbopol 940 in propylene glycol, 4% aqueous solution (25g) of Carbopol 940 and purified water (10g) were mixed uniformly by stirring, and triethanolamine (0.05g) was added to the mixture while continuing the stirring. To the gel base thus prepared, the alcoholic solution of diclofenac sodium prepared previously was added and the whole was adjusted to 100g by further addition of purified water. After stirring well, a gel preparation having a viscosity of 23,000 centipoise and a pH of 5.4 was obtained.

#### Referential Example 3

Diclofenac sodium (1.0g) was dissolved in 95% ethanol (20g) by stirring. Separately, 3% solution (40g) of Carbopol 940 in propylene glycol, 4% aqueous solution (10g) of Carbopol 940 and purified water (25g) were mixed uniformly by stirring, and triethanolamine (0.8g) was added to the mixture while continuing the stirring. To the gel base thus prepared, the alcoholic solution of diclofenac sodium previously prepared was added and the whole was adjusted to 100g by further adding purified water. After stirring well, a gel preparation having a viscosity of 21,000 centipoise and a pH of 5.8 was obtained.

Next, comparison between the gel preparations of the

above Examples and the gel preparation of the Referential Examples was effected with regard to the stability of diclofenac sodium with the lapse of time. More precisely, the content of diclophenac sodium in each preparation was measured just after the preparation was obtained and after the lapse of a prescribed time, according to the method of analysis as described hereinafter. The changes with the lapse of time in the content of diclofenac sodium in the preparation of Example 1 are shown in Fig. 1, and those of the preparations of Referential Examples 1 to 3 are shown in Figs. 2 to 4, respectively (abscissa: days elapsed, ordinate: percentages of the active ingredient contained in the preparation, taking that just after the preparation is obtained as the 100%).

It is apparent from these Figures that the preparation of Example 1 is significantly high in the stability with the lapse of time, as compared with the preparations of the Referential Examples.

The measurement of the content of diclofenac sodium in the above gel preparation was effected by extracting diclofenac sodium with ethanol, isolating diclofenac sodium from the extract by high-speed liquid chromatography (column: Lichrosorb RP<sub>18</sub>, developing agent: methanol/water/acetic acid - 600 : 400 : 5, room temperature), and determining the ultraviolet absorbance (254 nm).

What is claimed is

- 1) A gel preparation for external application characterized by being prepared from diclofenac sodium as the active ingredient, water, lower alkanols and glycols as medium, a carboxyvinyl polymer as gelating agent and a weak basic substance as neutralizing agent.
- 2) A gel preparation as claimed in claim 1, wherein the content of diclofenac sodium is 0.3 to 3% by weight.
- 3) A gel preparation as claimed in claim 1, wherein the weak basic substance is an aliphatic amine.
- 4) A gel preparation as claimed in claim 3, wherein the aliphatic amine is a primary, secondary or tertiary alkanolamine, or a primary, secondary or tertiary alkylamine.
- 5) A gel preparation as claimed in claim 3, wherein the weak basic substance is triethanolamine or diisopropanolamine.
- 6) A gel preparation as claimed in claim 1, which is adjusted at a pH of 6 to 8 with the neutralizing agent.
- 7) A gel preparation as claimed in claim 1, wherein the lower alkanol is ethanol or propanol and the glycol is ethylene glycol, propylene glycol or 1,3-butylene glycol.
- 8) A gel preparation as claimed in claim 1, which further contains peppermint oil, l-menthol or salicylic acid ester added there to as auxiliary agent.
- 9) A gel preparation as claimed in claim 8, wherein the

salicylic acid ester is methyl salicylate, ethyl salicylate or glycol salicylate.

10) A gel preparation as claimed in claim 1, wherein the medium is used in such amount as is sufficient at least to dissolve the active ingredient and as constitutes the whole preparation together with the active agent, the gelating agent, the neutralizing agent, etc.

11) A gel preparation as claimed in claim 1, wherein the ratio by weight of water to organic solvents in the medium is from 8 : 2 to 4 : 6.

12) A gel preparation as claimed in claim 1 or 11, wherein the ratio by weight of water: lower alkanol: glycol in the medium is about 60 : 30 : 10.

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FIG. 1

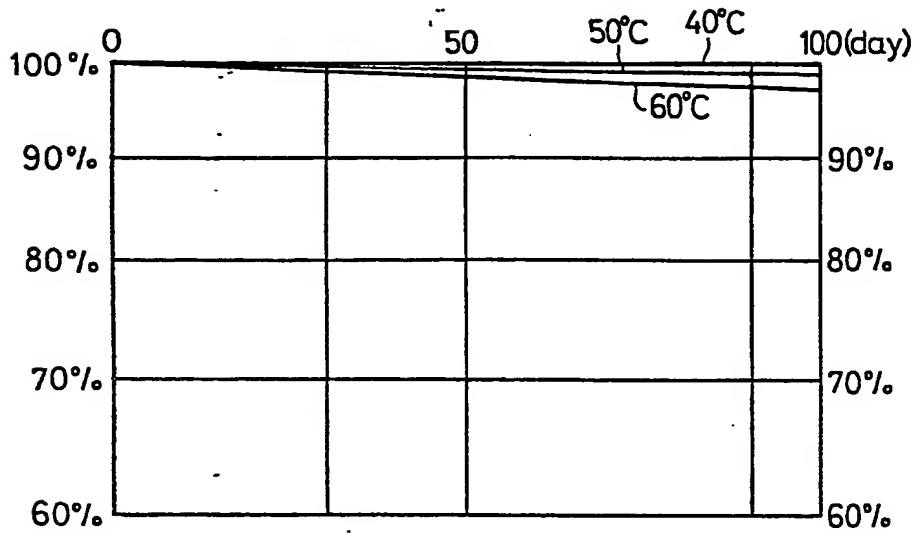
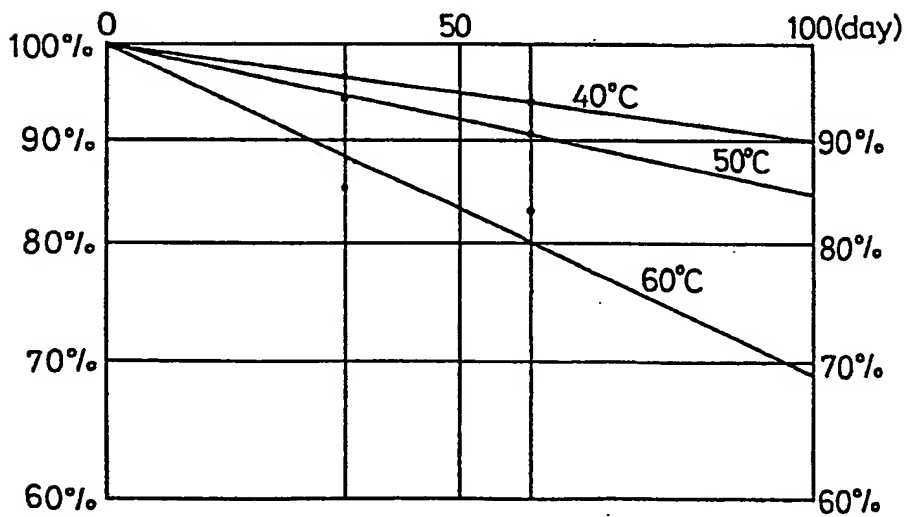


FIG. 2





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FIG. 3

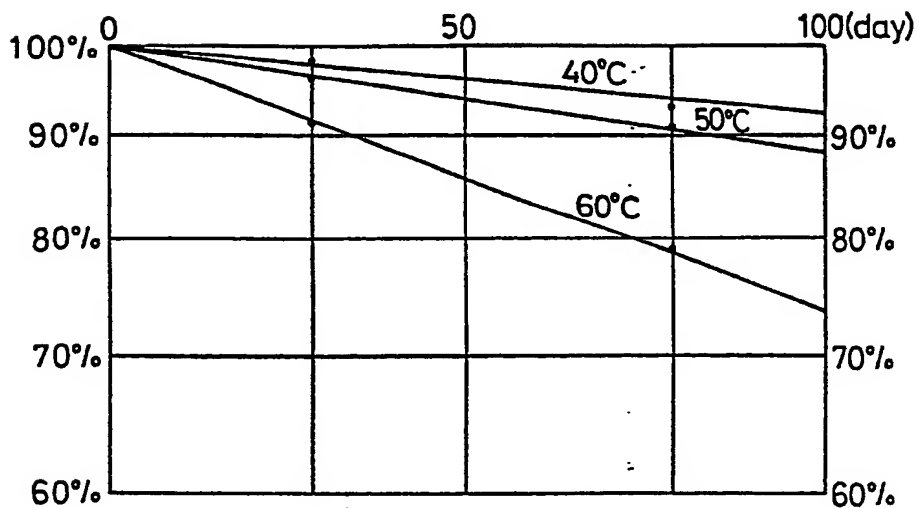
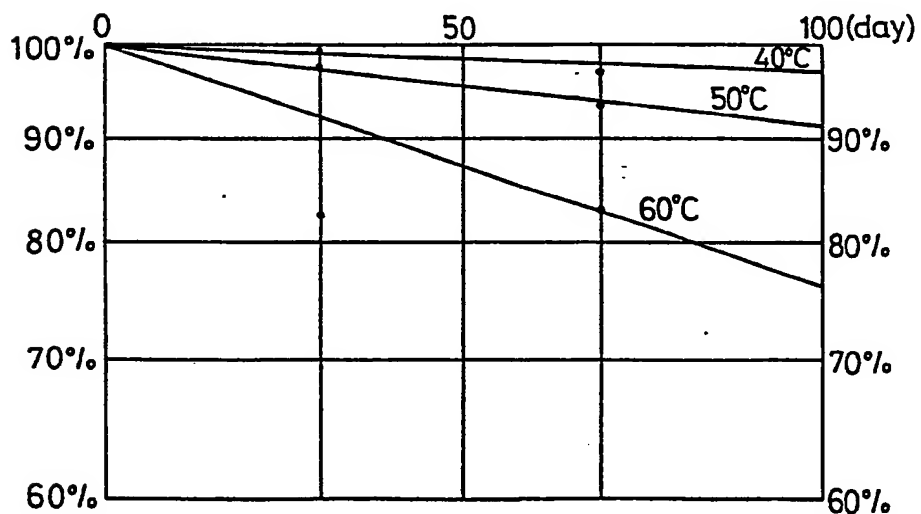


FIG. 4





European Patent  
Office

# EUROPEAN SEARCH REPORT

0147476  
Application number

EP 83 11 2373

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	FR-A-2 500 751 (ECKERT) * Pages 26,27, example 10 *	1-7,10 -12	A 61 K 31/195 A 61 K 47/00
Y		8,9	
Y	--- US-A-3 524 916 (HIROYUKI) * Column 1, lines 53-72; column 2, lines 23-70 *	8,9	
Y	--- CHEMICAL ABSTRACTS, vol. 98, no. 16, 16th April 1983, page 367, no. 132249w, Columbus, Ohio, USA; K. KYUKI et al.: "Antiinflammatory effect of diclofenac sodium ointment (cream) in topical application" & JPN. J. PHARMCOL. 1983, 33(1), 121-132	1-12	
Y	--- GB-A-2 023 000 (KOWA COMPANY LTD.) * Page 1, line 1 - page 4, line 7; claims *	1-12	A 61 K
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10-08-1984	Examiner BENZ K.F.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	